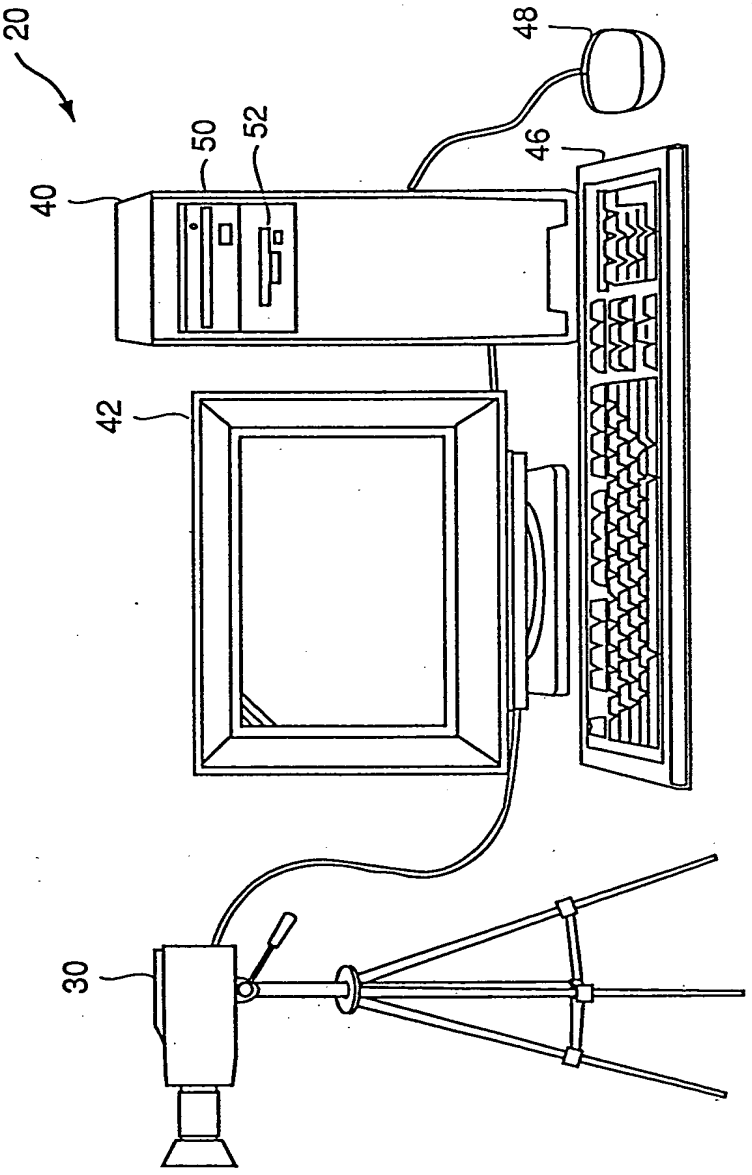


FIG. 1

FIG.2

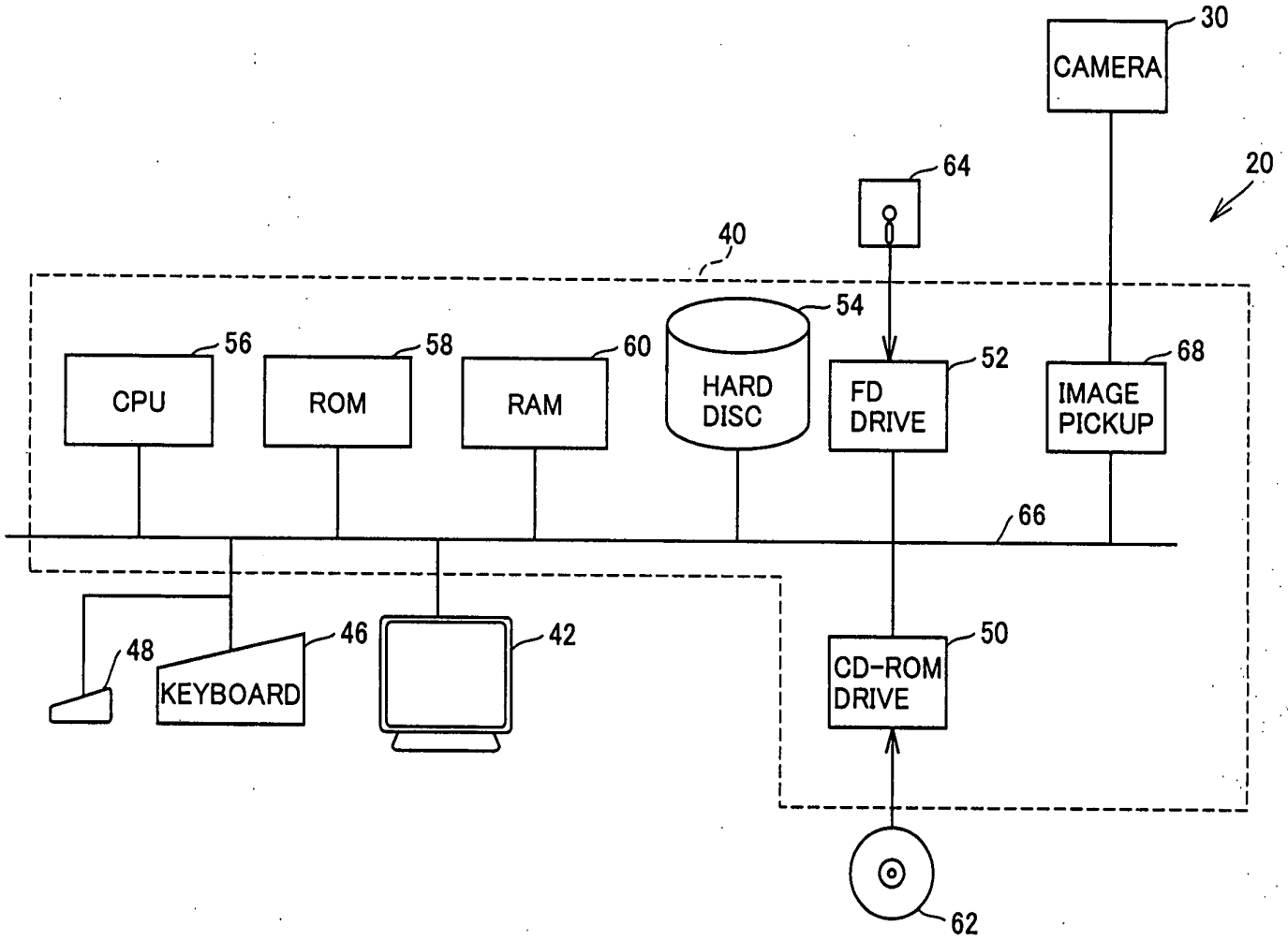

CAMERA
30
20
64
40
54
56
58
60
CPU
ROM
RAM
HARD DISC
52
FD DRIVE
68
IMAGE PICKUP
66
48
46
KEYBOARD
42
50
CD-ROM DRIVE
62

FIG. 3

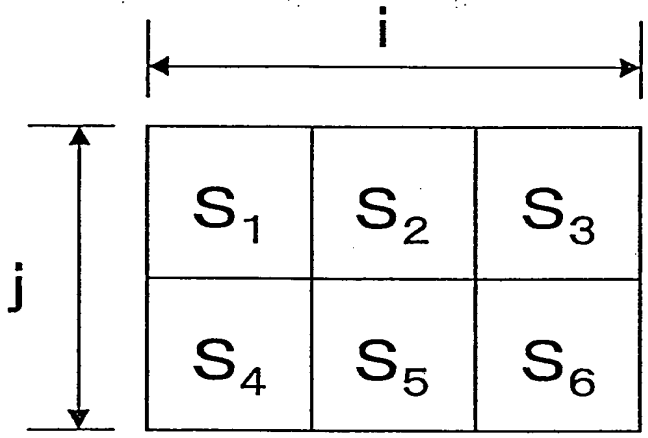


FIG. 4 A

S1	S2	S3
S4	S5	S6

FIG. 4 B

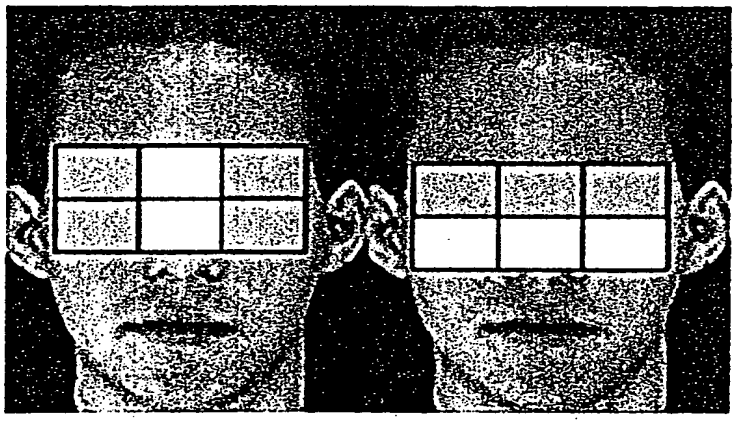


FIG.5

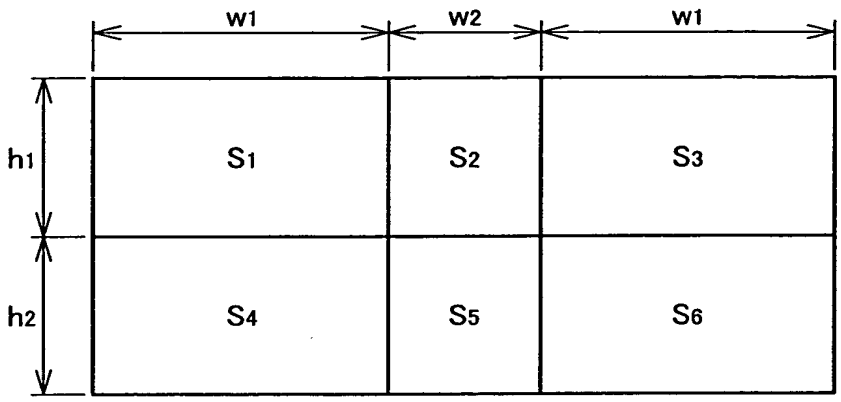


FIG. 6

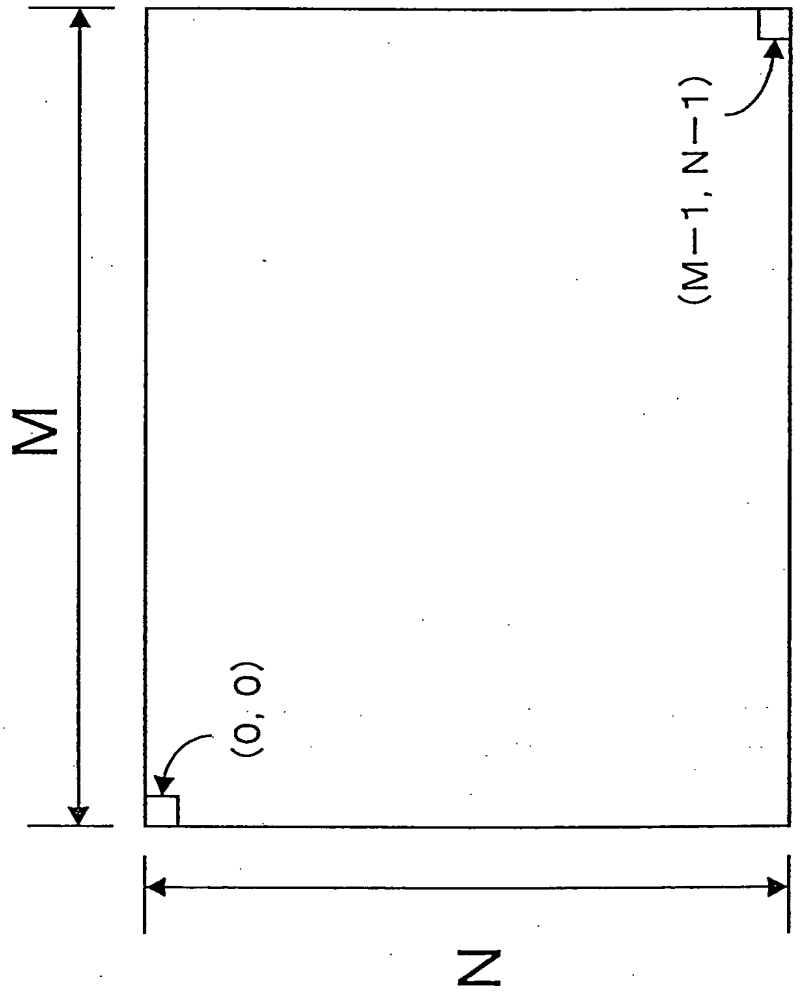


FIG.7

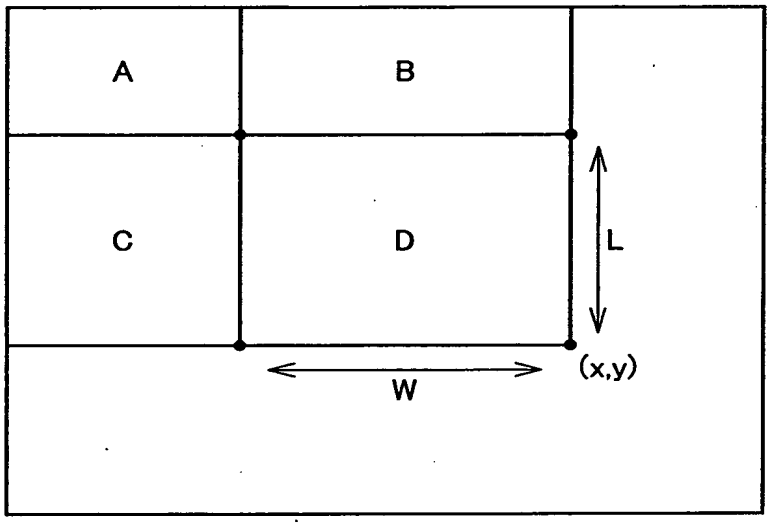


FIG.8

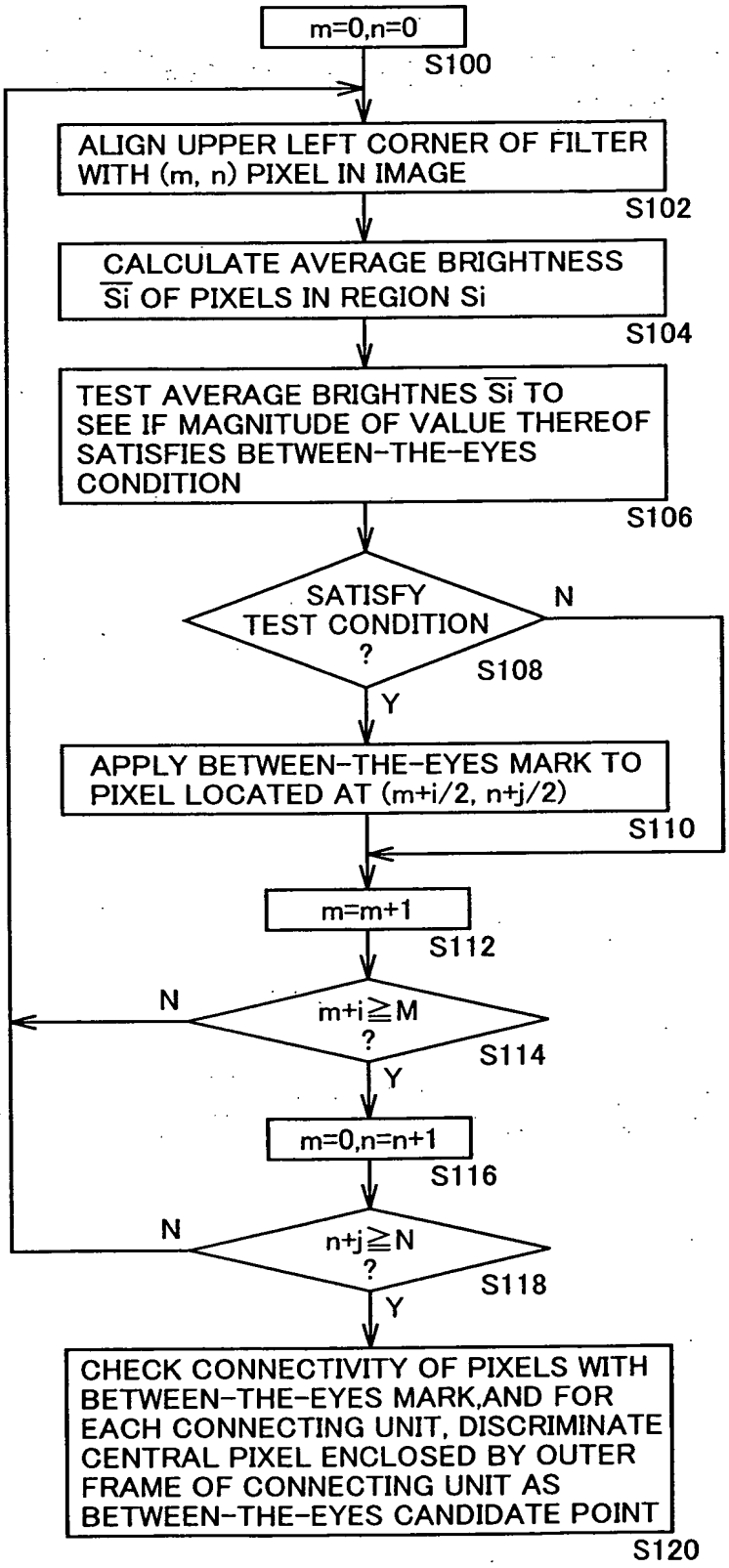

m=0,n=0
S100
ALIGN UPPER LEFT CORNER OF FILTER WITH (m, n) PIXEL IN IMAGE
S102
CALCULATE AVERAGE BRIGHTNESS $\overline{Si}$ OF PIXELS IN REGION Si
S104
TEST AVERAGE BRIGHTNES $\overline{Si}$ TO SEE IF MAGNITUDE OF VALUE THEREOF SATISFIES BETWEEN-THE-EYES CONDITION
S106
SATISFY TEST CONDITION ?
S108
N
Y
APPLY BETWEEN-THE-EYES MARK TO PIXEL LOCATED AT (m+i/2, n+j/2)
S110
m=m+1
S112
m+i≧M ?
S114
N
Y
m=0,n=n+1
S116
n+j≧N ?
S118
N
Y
CHECK CONNECTIVITY OF PIXELS WITH BETWEEN-THE-EYES MARK,AND FOR EACH CONNECTING UNIT, DISCRIMINATE CENTRAL PIXEL ENCLOSED BY OUTER FRAME OF CONNECTING UNIT AS BETWEEN-THE-EYES CANDIDATE POINT
S120

FIG. 9A

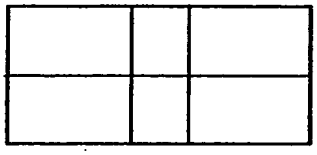


FIG. 9B

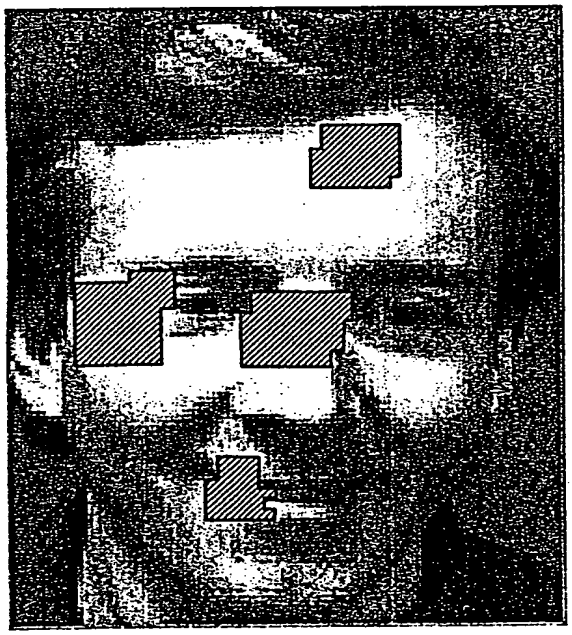
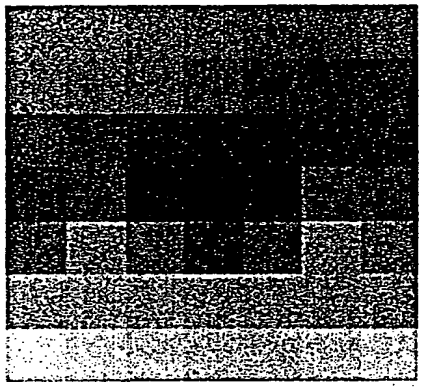


FIG. 10



TEMPLATE FOR RIGHT EYE

FIG.11

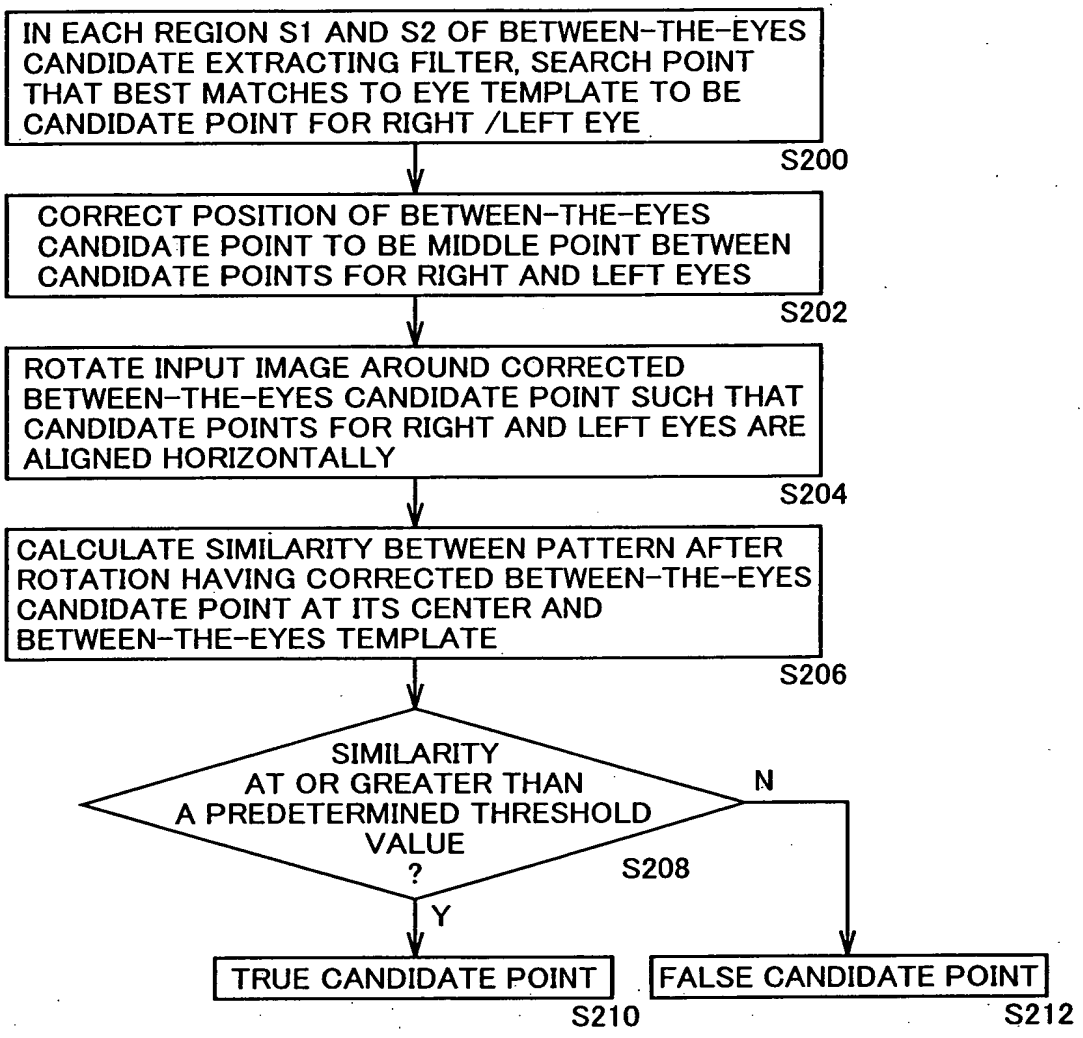

IN EACH REGION S1 AND S2 OF BETWEEN-THE-EYES CANDIDATE EXTRACTING FILTER, SEARCH POINT THAT BEST MATCHES TO EYE TEMPLATE TO BE CANDIDATE POINT FOR RIGHT /LEFT EYE
S200
CORRECT POSITION OF BETWEEN-THE-EYES CANDIDATE POINT TO BE MIDDLE POINT BETWEEN CANDIDATE POINTS FOR RIGHT AND LEFT EYES
S202
ROTATE INPUT IMAGE AROUND CORRECTED BETWEEN-THE-EYES CANDIDATE POINT SUCH THAT CANDIDATE POINTS FOR RIGHT AND LEFT EYES ARE ALIGNED HORIZONTALLY
S204
CALCULATE SIMILARITY BETWEEN PATTERN AFTER ROTATION HAVING CORRECTED BETWEEN-THE-EYES CANDIDATE POINT AT ITS CENTER AND BETWEEN-THE-EYES TEMPLATE
S206
SIMILARITY AT OR GREATER THAN A PREDETERMINED THRESHOLD VALUE ?
S208
N
Y
TRUE CANDIDATE POINT
S210
FALSE CANDIDATE POINT
S212

FIG. 12

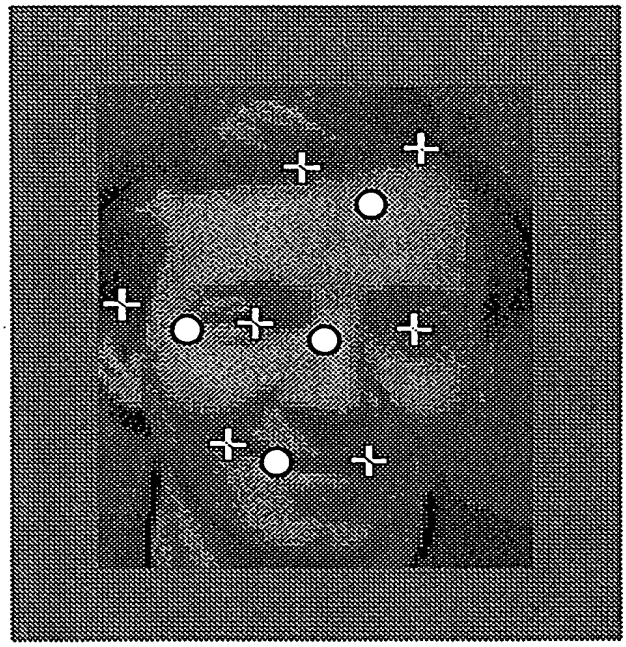


FIG.13

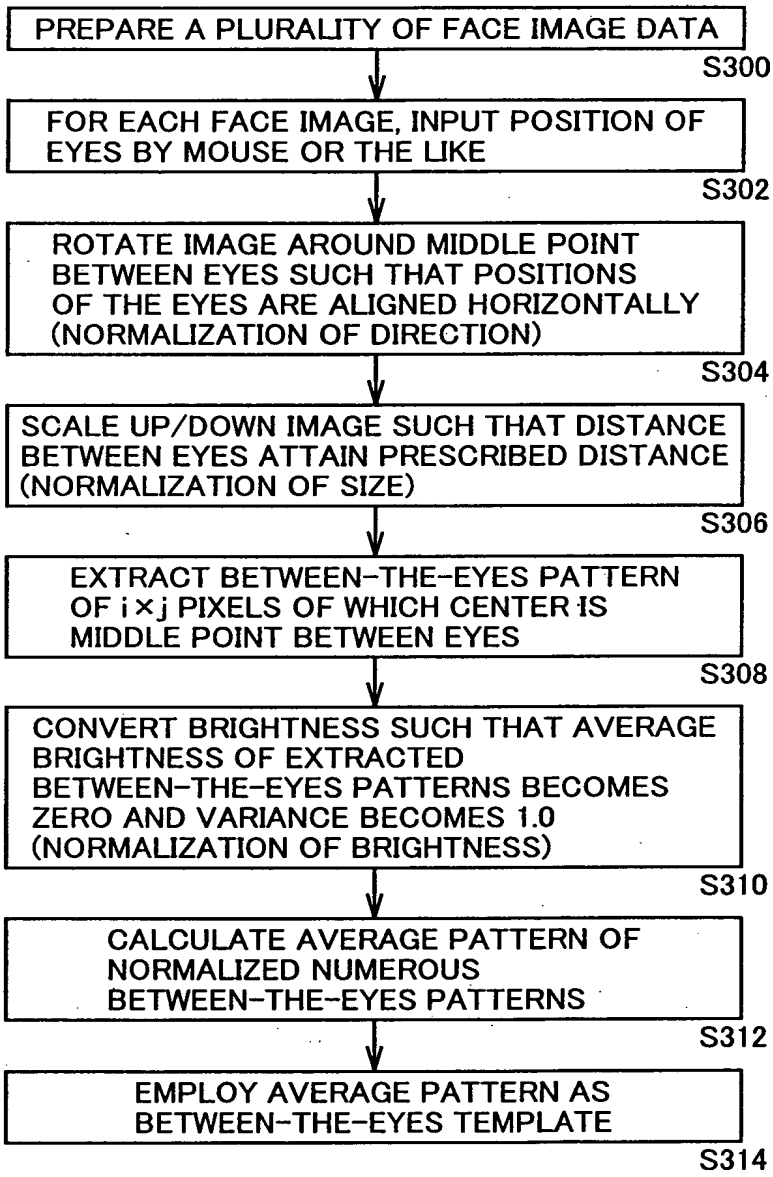

PREPARE A PLURALITY OF FACE IMAGE DATA
S300
FOR EACH FACE IMAGE, INPUT POSITION OF EYES BY MOUSE OR THE LIKE
S302
ROTATE IMAGE AROUND MIDDLE POINT BETWEEN EYES SUCH THAT POSITIONS OF THE EYES ARE ALIGNED HORIZONTALLY (NORMALIZATION OF DIRECTION)
S304
SCALE UP/DOWN IMAGE SUCH THAT DISTANCE BETWEEN EYES ATTAIN PRESCRIBED DISTANCE (NORMALIZATION OF SIZE)
S306
EXTRACT BETWEEN-THE-EYES PATTERN OF i×j PIXELS OF WHICH CENTER IS MIDDLE POINT BETWEEN EYES
S308
CONVERT BRIGHTNESS SUCH THAT AVERAGE BRIGHTNESS OF EXTRACTED BETWEEN-THE-EYES PATTERNS BECOMES ZERO AND VARIANCE BECOMES 1.0 (NORMALIZATION OF BRIGHTNESS)
S310
CALCULATE AVERAGE PATTERN OF NORMALIZED NUMEROUS BETWEEN-THE-EYES PATTERNS
S312
EMPLOY AVERAGE PATTERN AS BETWEEN-THE-EYES TEMPLATE
S314

FIG. 14A

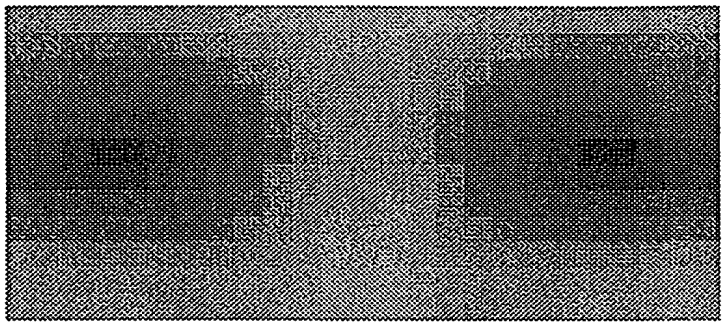


FIG. 14B

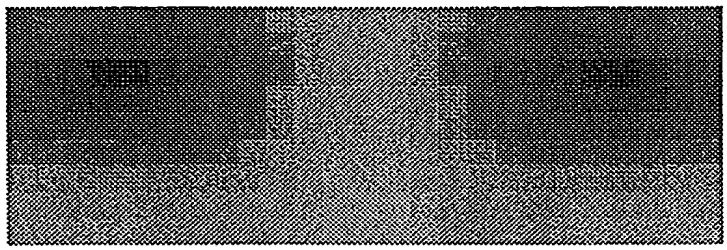


FIG.15

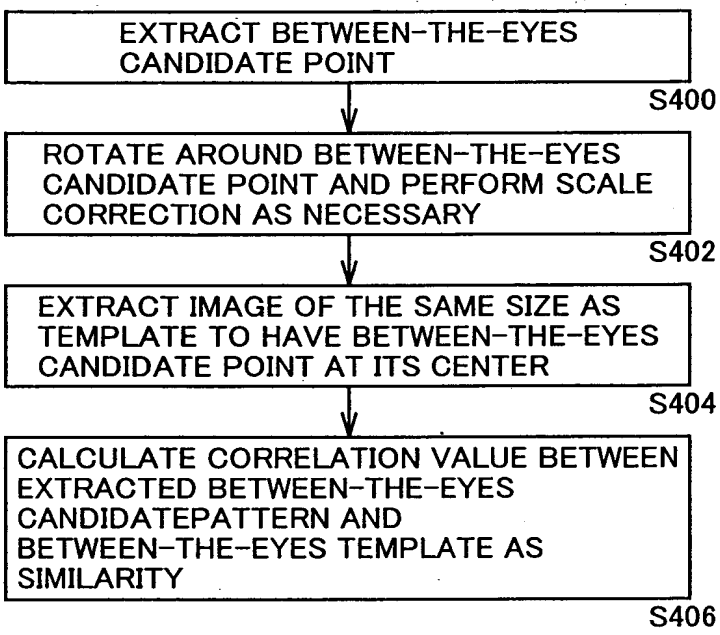

EXTRACT BETWEEN-THE-EYES CANDIDATE POINT
S400
ROTATE AROUND BETWEEN-THE-EYES CANDIDATE POINT AND PERFORM SCALE CORRECTION AS NECESSARY
S402
EXTRACT IMAGE OF THE SAME SIZE AS TEMPLATE TO HAVE BETWEEN-THE-EYES CANDIDATE POINT AT ITS CENTER
S404
CALCULATE CORRELATION VALUE BETWEEN EXTRACTED BETWEEN-THE-EYES CANDIDATEPATTERN AND BETWEEN-THE-EYES TEMPLATE AS SIMILARITY
S406

FIG. 16

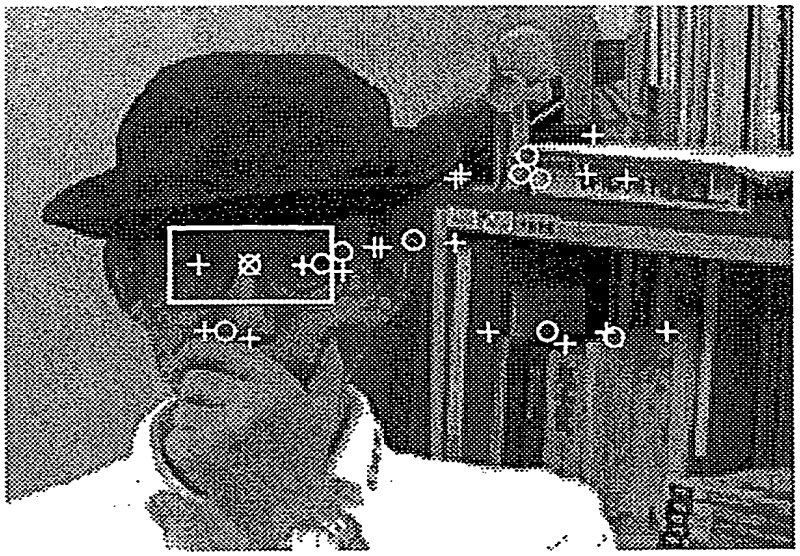


FIG. 17

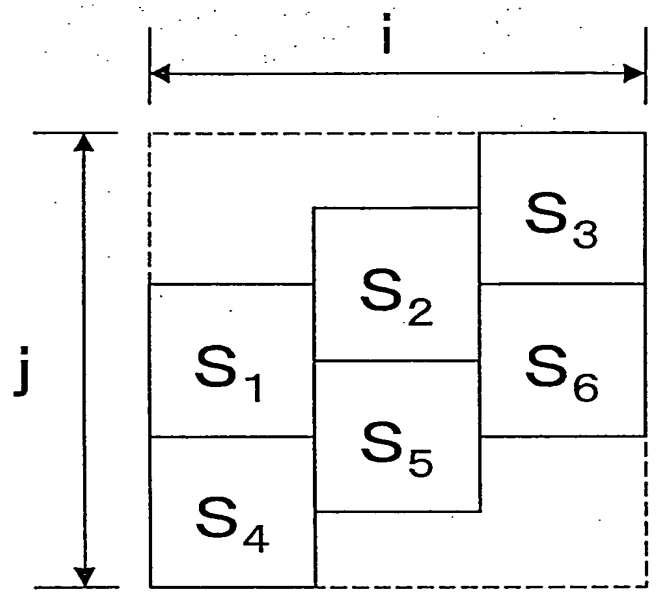


FIG. 18

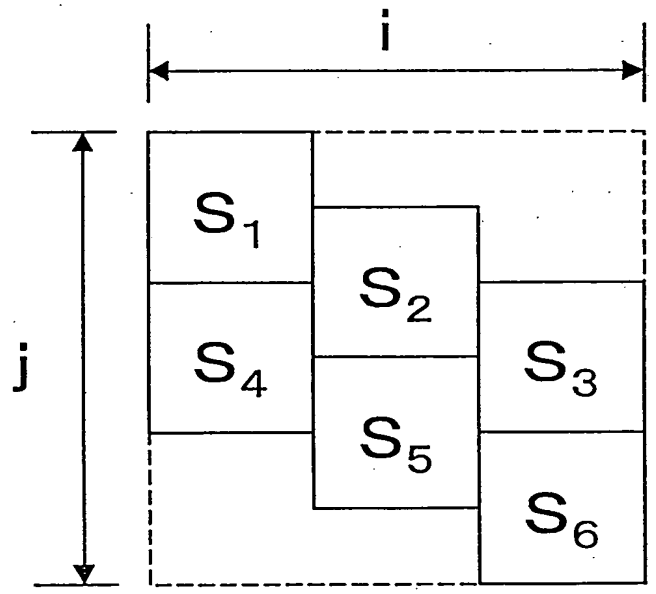


FIG.19

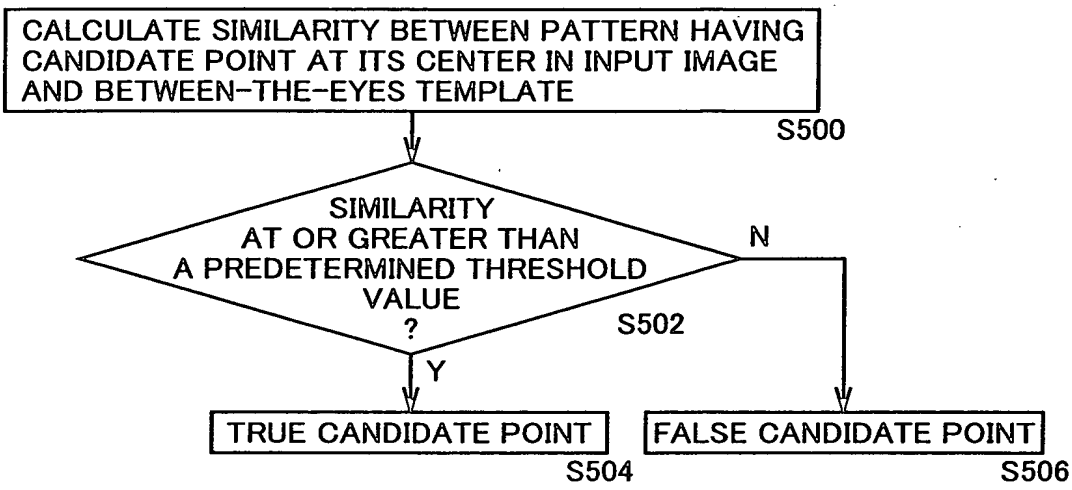

CALCULATE SIMILARITY BETWEEN PATTERN HAVING CANDIDATE POINT AT ITS CENTER IN INPUT IMAGE AND BETWEEN-THE-EYES TEMPLATE
S500
SIMILARITY AT OR GREATER THAN A PREDETERMINED THRESHOLD VALUE ?
S502
N
Y
TRUE CANDIDATE POINT
S504
FALSE CANDIDATE POINT
S506

FIG.20

PERFORMANCE EXAMINATION RESULT OF
SIX-SEGMENTED RECTANGULAR FILTER (TOTAL 400)

RECTANGULAR FILTER SIZE	SCALE OF SIZE	RECIPROCAL OF SCALE	NUMBER OF FAILURE (PIECES)	NUMBER OF CANDIDATE POINT (PIECES (AVERAGE))	EXTRACTING RATE (%)
24 × 12	0.3	3.3	13	17	96.8
36 × 18	0.6	1.67	11	8	97.25
48 × 24	0.8	1.25	15	5	96.25
60 × 30(REFERENCE)	1.0	1.0	33	4	92.0
72 × 36	1.2	0.83	42	3	89.5
84 × 42	1.4	0.71	192	3	52.0

FIG. 21

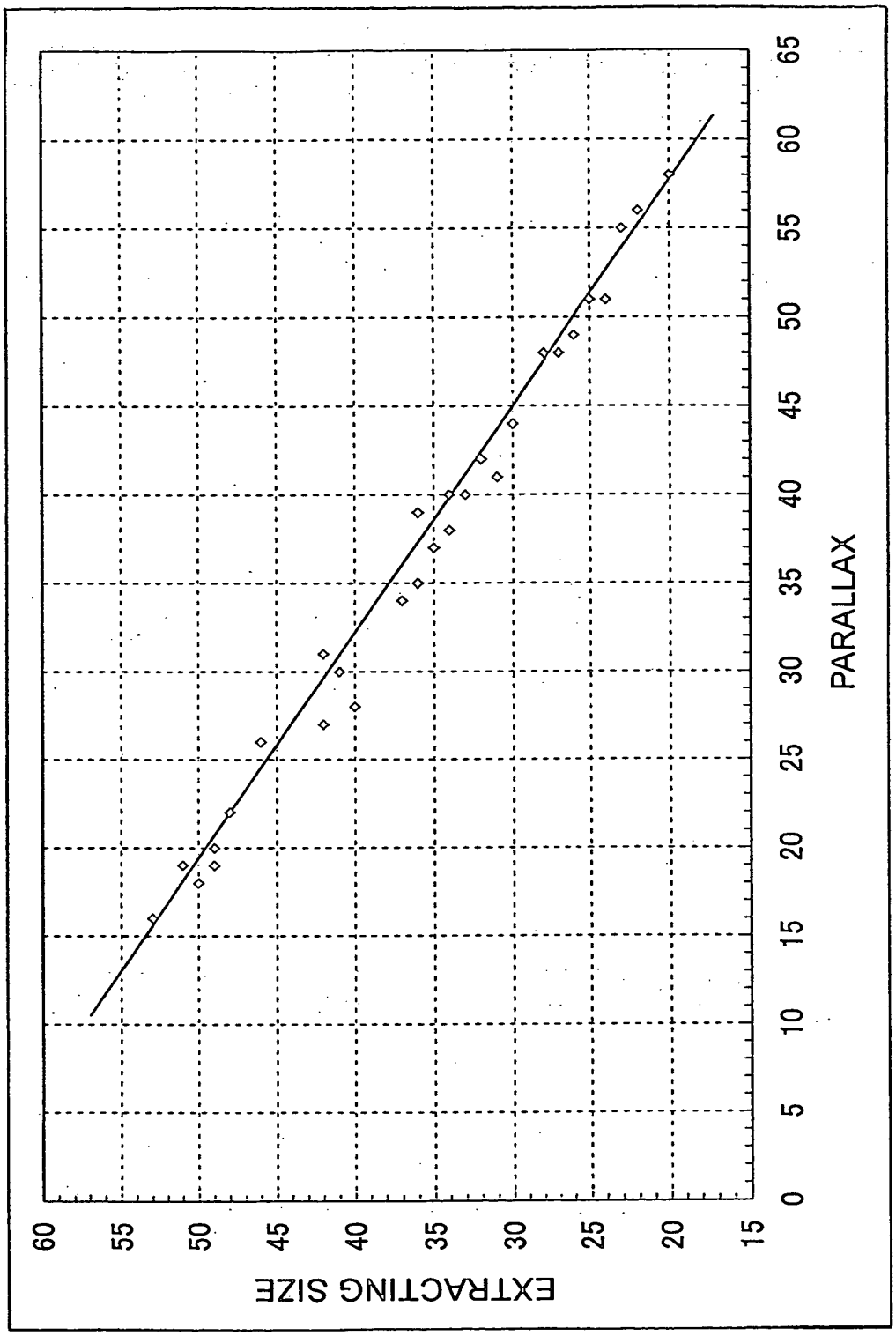

EXTRACTING SIZE
60
55
50
45
40
35
30
25
20
15
0
5
10
15
20
25
30
35
40
45
50
55
60
65
PARALLAX

FIG.22

RELATIONSHIP AMONG FILTER SIZE, PARALLAX AND EXTRACTING SIZE

FILTER SIZE	FILTER SIZE	PARALLAX	EXTRACTING SIZE
40×20	—	10～15	56×28
	—	15～20	52×26
	—	20～25	48×24
	—	25～30	44×22
	24×12	30～35	40×20
		35～40	36×18
—		40～45	32×16
—		45～50	28×14
—		50～55	24×12
—		55～60	20×10

FIG.23

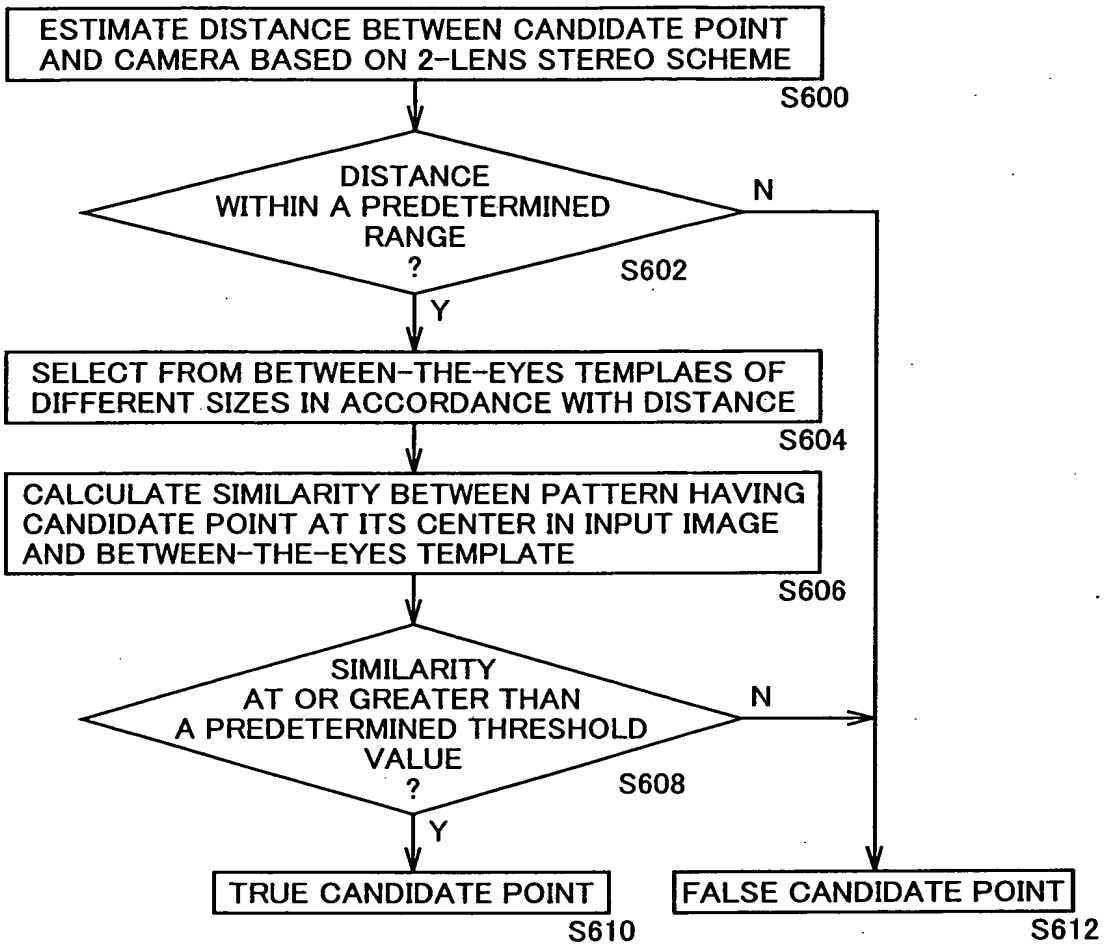

ESTIMATE DISTANCE BETWEEN CANDIDATE POINT AND CAMERA BASED ON 2-LENS STEREO SCHEME
S600
DISTANCE WITHIN A PREDETERMINED RANGE ?
S602
N
Y
SELECT FROM BETWEEN-THE-EYES TEMPLAES OF DIFFERENT SIZES IN ACCORDANCE WITH DISTANCE
S604
CALCULATE SIMILARITY BETWEEN PATTERN HAVING CANDIDATE POINT AT ITS CENTER IN INPUT IMAGE AND BETWEEN-THE-EYES TEMPLATE
S606
SIMILARITY AT OR GREATER THAN A PREDETERMINED THRESHOLD VALUE ?
S608
N
Y
TRUE CANDIDATE POINT
S610
FALSE CANDIDATE POINT
S612

FIG.24

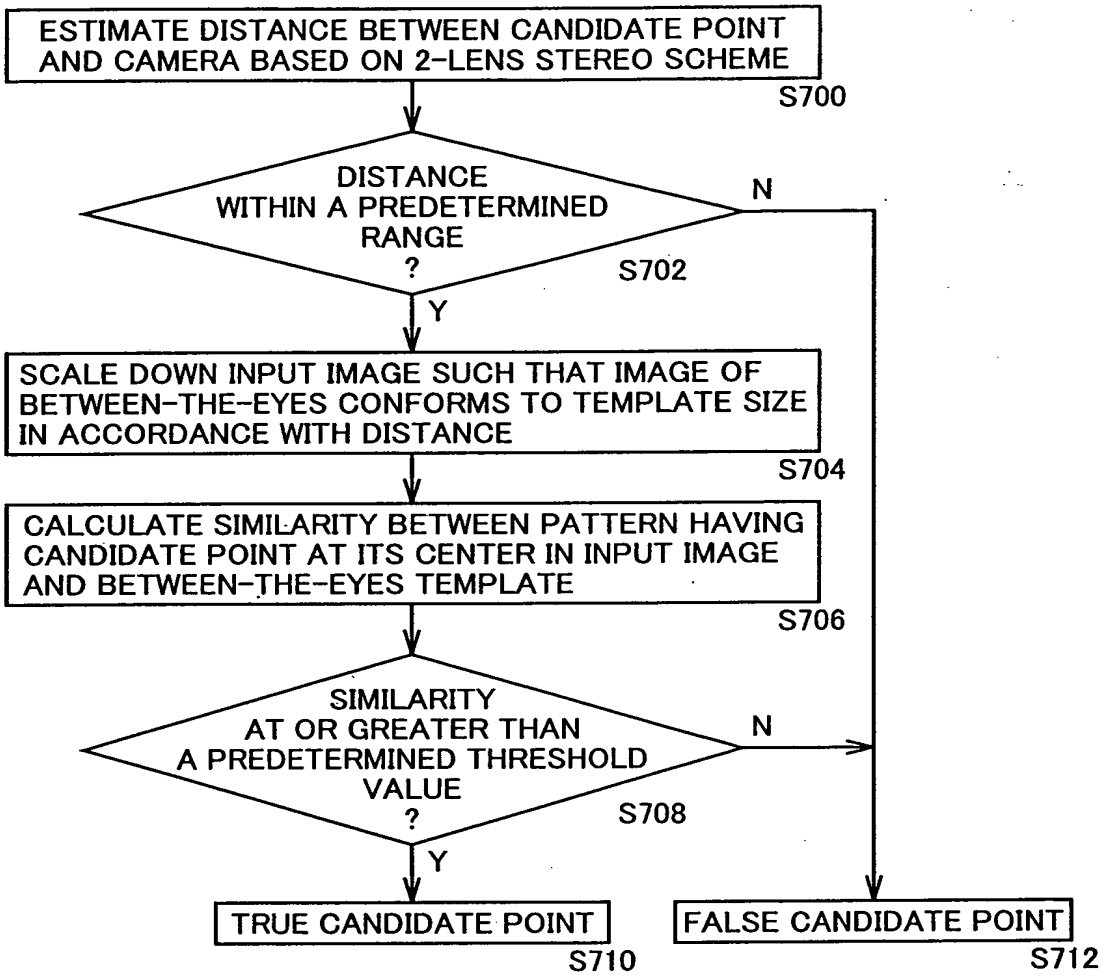

ESTIMATE DISTANCE BETWEEN CANDIDATE POINT AND CAMERA BASED ON 2-LENS STEREO SCHEME
S700
DISTANCE WITHIN A PREDETERMINED RANGE ?
S702
N
Y
SCALE DOWN INPUT IMAGE SUCH THAT IMAGE OF BETWEEN-THE-EYES CONFORMS TO TEMPLATE SIZE IN ACCORDANCE WITH DISTANCE
S704
CALCULATE SIMILARITY BETWEEN PATTERN HAVING CANDIDATE POINT AT ITS CENTER IN INPUT IMAGE AND BETWEEN-THE-EYES TEMPLATE
S706
SIMILARITY AT OR GREATER THAN A PREDETERMINED THRESHOLD VALUE ?
S708
N
Y
TRUE CANDIDATE POINT
S710
FALSE CANDIDATE POINT
S712

FIG. 25

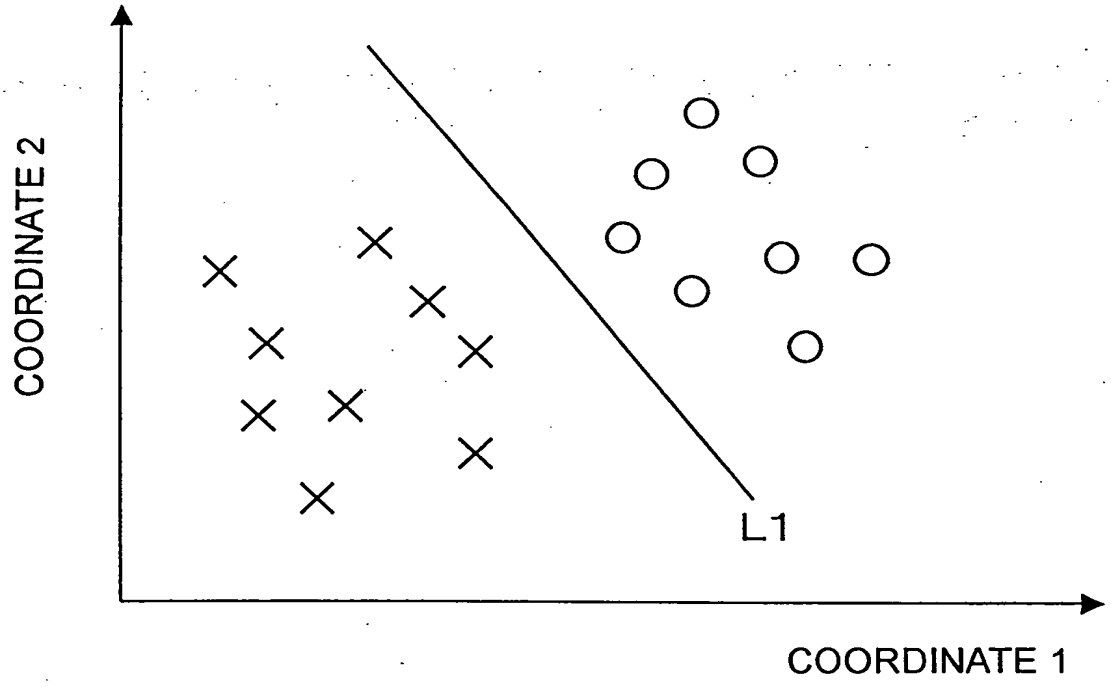
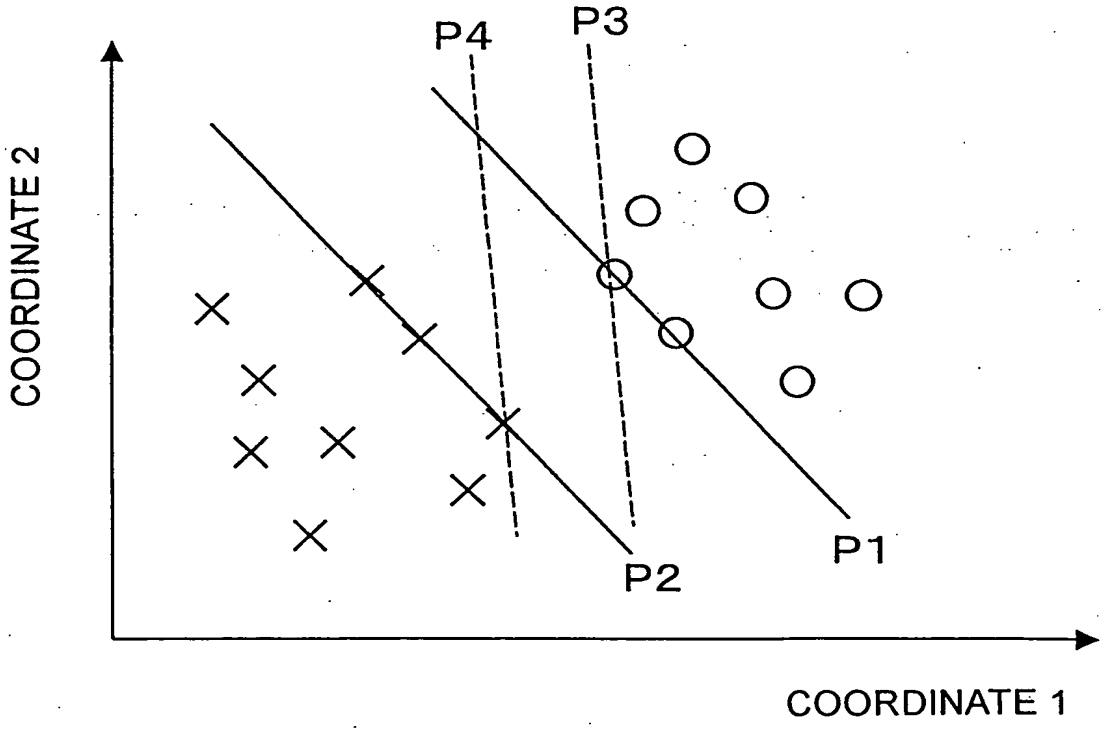

COORDINATE 2
L1
COORDINATE 1

FIG. 26


P4
P3
COORDINATE 2
P2
P1
COORDINATE 1